PAWTUXET RIVER FLOOD CONTROL PROJECT

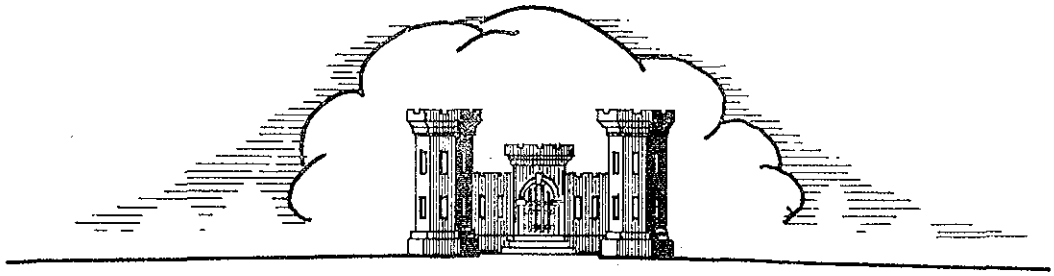
T. S. Burns

CLYDE DIKE

PAWTUXET RIVER, R. I.

DEFINITE PROJECT REPORT

(PRELIMINARY)



WAR DEPARTMENT CORPS OF ENGINEERS U. S. ARMY
U. S. ENGINEER OFFICE PROVIDENCE, R. I.

JUNE 1944

War Department
United States Engineer Office
Providence, Rhode Island

PAWTUXET RIVER FLOOD CONTROL PROJECT

PRELIMINARY

DEFINITE PROJECT REPORT

CLYDE DIKE

PAWTUXET RIVER, RHODE ISLAND

June 1944

PRELIMINARY
DEFINITE PROJECT REPORT
CLYDE DIKE
PAWTUXET RIVER, RHODE ISLAND

C O N T E N T S

INDEX TO PLATES

WAR DEPARTMENT
United States Engineer Office
Providence, Rhode Island

PAWTUXET RIVER FLOOD CONTROL PROJECT

PRELIMINARY
DEFINITE PROJECT REPORT
CLYDE DIKE
NORTH BRANCH OF PAWTUXET RIVER, RHODE ISLAND

1. Authorization. - Flood Control Act approved 18 August 1941 (Public No. 228, 77th Congress, 1st Session).

2. Basic Report. - The project is one of two units in the comprehensive plan for the control of floods in the Pawtuxet River Basin, R. I. (House Document No. 747; 76th Congress, 3rd Session) and provides for the protection of a low lying, industrial and residential area of Clyde Village in the Town of West Warwick by means of a system of earth dikes and concrete flood walls supplemented by a pumping plant to maintain drainage in the protected area.

3. Location and Description of Area Affected.

a. The village of Clyde is located in the Town of West Warwick, Kent County, R. I. and lies on the east bank of the North Branch of the Pawtuxet River approximately 0.5 mile upstream from the confluence of the North and Southwest Branches which forms the main stream, and approximately eleven miles upstream from the mouth of the Pawtuxet River. That portion of the village which is subject to inundation lies on a low plain formed by a horseshoe bend in the river and is bounded on the south, east, and west sides by the river. The north boundary of the area is formed by the railroad embankment of the Pawtuxet Valley Branch of the New York, New Haven and Hartford Railroad. The low plain affected is a highly developed industrial and residential area of approximately thirty-seven acres. The major property within this area is the plant of the Allied Textile Printers, Inc., a large modern print and dye works which employes from

three hundred to five hundred persons depending upon the current volume of business. In addition, the area contains a lumber yard, a few stores and several blocks of houses.

b. There are no existing flood protection works for this area.

c. Although Clyde Dike is one of two units in the comprehensive plan for the control of floods in the Pawtuxet River Basin, there is no relation between the Clyde Dike project and the second unit of the comprehensive plan. The second unit is known as the Pontiac Diversion and consists of a diversion dam and channel located approximately three miles downstream from Clyde.

4. Definite Project Plan.

a. The areas subjected to flooding and the proposed plan of protection are shown on the attached map. The program involves the construction of approximately 3,150 linear feet of earth dike and concrete flood wall which will form a three sided loop around the protected area and will terminate at the high railroad embankment which forms the northern boundary of the area at either end. A pumping station will be required to provide for internal drainage of 24 acres. The existing tributary drainage area of 152 acres will be reduced by the construction of a 36-inch pressure conduit 550 feet long to the river.

b. The design, or project flood as proposed, is 25,200 cubic feet per second without modification by existing storage (238 c.f.s. per sq. mile over 106 sq. mi.). However, the existence of the Scituate Reservoir on the North Branch upstream from Clyde effects a modification of the project flood by the utilization of the large existing storage provided by the reservoir. The drainage area of Scituate Reservoir is 92.8 square miles. The design flood modified by the surcharge storage effect of this reservoir is 19,400 cubic feet per second (183 c.f.s. per sq. mile). The proposed modified design flood is over twice as great as the maximum flood of record at Clyde (9660 c.f.s. in 1886). This flood occurred before

the Scituate Reservoir had been constructed. The approximate stages of the North Branch of the Pawtuxet River at Clyde for these flows are as follows:

Maximum flood of record, Feb. 1886	14.05 ft.
Design flood, unmodified	23.02 ft.
Design flood, modified by surcharge storage, Scituate Reservoir	19.90 ft.

5. Type of Structure and Engineering Features. See attached drawings.

a. Grades. - The proposed grades in feet above mean sea level are as follows:

At Railroad Embankment (upstream end of dike)	77.2
At Main Street Bridge	71.5
At Railroad Embankment (downstream end of dike)	70.0

The earth dike sections are designed to provide a freeboard of 3 feet above the given grades. The tops of concrete walls will be 1 foot higher than the above grades thus providing a freeboard of 1 foot.

b. Earth Dike Section. - The proposed earth dike work consists of a section which will have a ten foot crown width with riverside slopes of 2-1/2 on 1 and landside slopes of 2 on 1. The embankment will consist of pervious and random rolled fill on the landside with a blanket of impervious material forming the riverside face. The riverside slope of the dike will be faced with a protective surface of riprap where velocities of the water in the river so require. The remaining riverside slope and the entire top of dike and landside slope will be topsoiled, sodded and seeded. The impervious blanket on the riverside face will be extended into the natural ground at the toe of the dike by means of a cutoff trench. The landside toe of the dike will be provided with a toe drain for the purpose of intercepting and collecting seepage through and under the dike.

c. Concrete flood walls. - Concrete walls are proposed at those locations where space limitations will not permit the use of earth dike sections. All walls are of the cantilever type, of reinforced concrete, and are extended a sufficient depth into the ground to prevent any frost heaving action. The riverside toe of the wall is provided with a steel sheet pile cutoff to rock and the landside toe with a toe drain. The maximum height of concrete wall required is approximately 20 feet. A typical section of concrete wall is shown on Plate No. 4.

d. Foundation and Steel Sheet Piling. - Bore holes drilled at the locations indicated on the drawings indicate that the most prominently developed stratum in the foundation is made up of pervious sand and gravel averaging about 12 feet in thickness. Throughout about half the length of the protective works the upper portion of the foundation comprises fill materials of cinders, sand, and gravel. The entire reach of the dike is underlain by quartzitic bed rock at a depth of from 15 feet to 25 feet. This rock outcrops at numerous points north of the railroad embankment. All concrete wall sections of the proposed levee will be provided with a steel sheet pile cutoff to rock. Complete cutoff of the earth dike sections of the levee is not provided, since it is considered that seepage through the relatively narrow layer of pervious foundation can be adequately controlled by the horizontal pervious filter and the toe drain.

e. Main Street Closure. - At the point where the proposed dike crosses Main Street immediately north of the bridge, the design flood grade is 74.0, approximately 3 feet above the elevation of the street. It is proposed to extend the sheet pile cutoff across the highway and provide abutments on either side of Main Street between which a sand bag closure in time of flood can be effected.

f. River Channel Improvement. - As an integral part of the embankment construction operations, it is proposed to widen the existing river channel to a base width of 80 feet downstream from the Main Street Bridge by borrowing random material from the north river bank.

g. The proposed construction will have no appreciable effect on the flood plane of the river.

6. Internal Drainage.

a. Description of Local Drainage Areas. - An examination of the map of the drainage area tributary to the protected area (see Plate No. 2) indicates that this may be conveniently divided into two parts for study of the drainage and the disposal thereof:

(1) Area A. - This item comprises all the area south of the railroad tracks of the N.Y., N.H. & H. Railroad lying within the proposed protection. Area A consists of 24 acres of fully developed industrial and residential property and in general slopes gently from north to south. The area is probably developed to the maximum practicable extent under existing conditions.

(2) Area B. - This item comprises all the area north of the railroad tracks, which under existing conditions is tributary to the proposed protected area. Area B consists of 128 acres of partially developed residential property and in general slopes sharply from north to south. Further development of this area is possible although the growth of the community at this location in the past few years has been minor.

b. Existing Drainage Facilities. -

(1) Area A. - This area is now provided with a complete storm drainage disposal system of catch basins and storm sewers (see Plate No. 3 for detailed survey record). Under existing conditions the storm sewers discharge into the river or the canal of the Allied Textile Printers Mill.

(2) Area B. - This area is drained by open gutters and ditches with some storm sewers in the lower reaches. Under present conditions the entire volume of storm drainage flows south to a focus at the railroad embankment at which point it enters a 1 x 3 foot box culvert and passes into Area A. The inadequate size and poor construction

of this storm drain has given rise to frequent difficulty through minor flooding of property.

c. Local Rainfall and Runoff. -

(1) In computing the preliminary design rates of runoff, the average intensity of precipitation used was that for the two hours of most intense rainfall of a storm having a frequency of 10 years for the month of July as derived from studies of rainfall records for the City of Providence, R. I. The use of a 10-year - 2-hour storm has been adopted as a standard for the most intense storm for which it is considered economically justifiable to provide pumping capacity, even in highly developed urban areas.

(2) In computing runoff, the standard rainfall intensity is reduced for areas not requiring the maximum degree of protection by introducing a multiplier called the relative-protection-factor (R.P.F.). When providing protection for a composite interior drainage area, it is not necessary to furnish the same degree of protection for a partially developed residential area as for a fully developed industrial area. Allowance for this is made by introducing the R.P.F. which is the index of the amount of protection which is provided for one area relative to another. The R.P.F. is defined as the ratio of the intensity of precipitation used in computing the runoff from a given area to the intensity of precipitation of the basic design storm. The adopted basic rainfall intensity multiplied by the R.P.F. gives the rainfall intensity for which protection is provided.

The following table shows the computation of runoff:

Sub-area	Type	Area-acres	Rainfall rate: in 1 hr.	R.P.F.	Runoff coeff.	Runoff c.f.s.
B	Partially developed residential	64	0.88	0.6	0.70	24
B	Partially developed residential	64	0.88	0.6	0.80	27
A	Fully developed industrial and residential	24	0.88	1.0	0.65	14

d. Selection of Type and Size of Proposed Structures. - The proposed facilities for the disposal of internal drainage will consist of the following:

(1) Pressure Conduit. - The disposal of the storm drainage from Area B will be by means of a 36-inch pressure conduit extending from the low point of Area B through the railroad embankment to the river at a point near the westerly end of the proposed dike. The length of the proposed pressure conduit is approximately 550 feet and the design capacity 51 cubic feet per second with the river at maximum flood stage.

(2) Pumping Station. - Since Area B does not contribute storm drainage to the protected area under the proposed plan, pumping capacity sufficient to discharge storm drainage from Area A only will be required. Since no appreciable volume of storage can be accumulated within the confined limits of the protected area the design discharge capacity of the station must be sufficient to take care of the full amount of runoff plus estimated seepage. This has been estimated as a minimum of 20 cubic feet per second against a static head of 15 feet. This design capacity includes an allowance for seepage flow of 6 c.f.s. under the dike. The pump installation will consist of two gasoline engine driven propeller pumps, each pump having a capacity of 90 percent of the total station capacity or 18 c.f.s. against a static head of 15 feet.

(3) Local Storm Drainage System. - Minor revisions to the existing storm drainage system will be performed at the expense of local interests.

7. Cost Estimate.

Item No.	Item	Quantity	Unit	Unit Price	Amount	Total
a.	**Dike.**					
	Clearing	10	Acres	$150.00	$ 1,500	
	Stripping	7,000	Cu.Yd.	.50	3,500	
	Excavation - Channel	36,000	Cu.Yd.	.35	12,600	
	Excavation - Cutoff trench	6,700	Cu.Yd.	.50	3,350	
	Excavation - Miscellaneous	3,200	Cu.Yd.	.40	1,300	
	Backfill	1,500	Cu.Yd.	.25	375	
	Embankment	70,000	Cu.Yd.	.65	45,500	
	Riprap (incl. 6" gravel)	4,000	Cu.Yd.	6.00	24,000	
	Concrete (Class A)	1,900	Cu.Yd.	20.00	38,000	
	Concrete (Class B)	100	Cu.Yd.	15.00	1,500	
	Reinforcing Steel	212,000	lb.	.05	10,600	
	Drains (concrete walls)	940	Lin.Ft.	3.25	3,055	
	Drains (earth dike)	2,090	Lin.Ft.	3.50	7,315	
	Steel Sheet Piling	13,000	Sq.Ft.	1.25	16,250	
	Misc. Gates, Valves		job		5,000	
	Misc. Canal Alterations		job		5,000	
						$178,845
b.	**Pumping Station and Drainage.**					
	Pressure Conduit		job		10,000	
	Pumping Station - Structure		job		12,000	
	Pumping Station - Equipment		job		15,000	
						37,000
			Total			$215,845
	Contingencies		20%			43,155
						259,000
	Engineering and Overhead		15%			39,000
	ESTIMATED CONSTRUCTION COST TO THE UNITED STATES					$298,000
c.	**Relocation of Utilities.**					
	Reloc. of Util. (incl. Storm, Sanitary and Water)		job		12,000	12,000
	Contingencies		20%			2,400
						14,400
	Engineering and Overhead		15%			2,200
						$ 16,600
d.	**Rights-of-way, Land, Damages.**					
	Rights-of-way and Land		L.S.		14,300	
	Damages		L.S.		5,400	
						$ 19,700
	Legal, Overhead and General Expenses		20%			3,900
						$ 23,600
	ESTIMATED TOTAL COST TO LOCAL INTERESTS					$ 40,200
	TOTAL ESTIMATED COST					$338,200

8. Economics.

a. The Survey Report for the Pawtuxet River estimated average annual losses within the area to be protected by the proposed Clyde Dike at $49,360 and more than adequate to justify annual charges of $18,310. However, due to changed conditions at the Allied Textile Printers, Inc., which is the principal concern protected, annual losses are determined to total $16,500, or somewhat less than the average annual costs.

b. The Allied Textile Printers, Inc. is a large modern print and dye works which has in the past sustained substantially all the damage at Clyde. Direct losses of record experienced by the previous management of the plant (The Perennial Print and Dye Co.) are as follows:

Date of Flood	Direct Loss
Feb. 1886	$18,000
Mar. 1936	38,500
July 1938	35,000

In the last few years the present management of the plant has taken corrective measurements to reduce flood damage and discontinued the use of a low stone building where valuable dye stuffs were stored. Recurring direct damage at a stage equivalent to the flood of July 1938 would be only $1500 in the future. The stage-damage curve was therefore revised and average annual benefits from the complete protection under present conditions were calculated at $16,500. The Allied Textile Printers, Inc. would receive substantially all the benefits of protection since the lumber yard, several blocks of stores and houses, and a gasoline station which are also within the area protected by the Clyde Dike are located above the level of all but the greatest floods. The occurrence of great floods at Clyde is rare due to the storage normally available at Scituate Reservoir.

c. Analysis of a 20-year record of operating conditions at Scituate Reservoir produces a duration curve of reservoir water surface and corresponding storage available for flood control

below top of the 16-inch flashboards with which the spillway is provided. The records show that the reservoir is full only 13% of the time and its lowest drawdown was about 21 feet, reached in 1930. The average flood control storage available below top of flash boards is 3.20 inches of runoff with respect to the 92.8 square miles of drainage area above the dam. This would amount to an average reduction of 2.80 inches of runoff with respect to the 106.0 sq. mi. of drainage area above Clyde. The remainder of the flood runoff would further be modified by the surcharge storage of Scituate Reservoir.

9. Local Cooperation. - The estimated cost to local interests for lands, damages, rights-of-way, and relocation of utilities is $40,000. For some time local interests have been giving consideration to the furnishing of assurances of the necessary local cooperation at the request of this office. At the present time it is not known definitely whether these assurances will be given.

10. Time Required for Construction. - It is estimated that a period of 9 months will be required for the construction of this project.

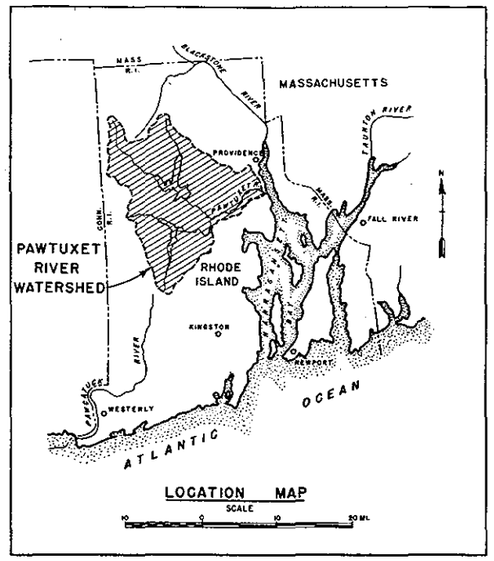
11. Recommendation.

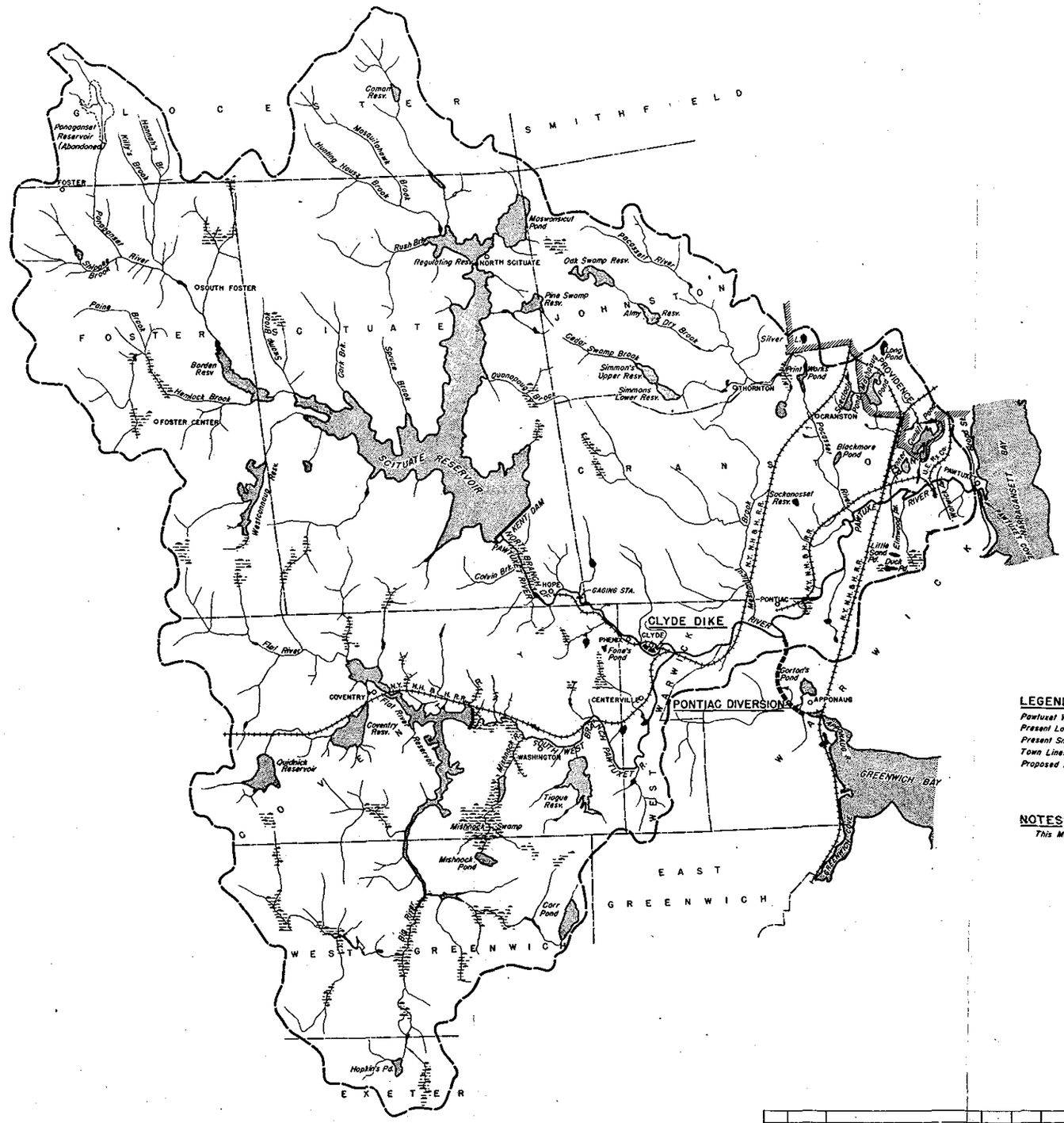
a. As the major share of the benefits accrue to a single concern and the economic ratio for the work is not definitely favorable under the changed conditions now existing at the property in question, it is recommended that the construction of the Clyde Dike be given low priority in scheduled work in this District unless subsequent factors indicate a more favorable action is desirable.

b. It is proposed to continue the preparation of plans and specifications for the Clyde Dike pending further action by the Office, Chief of Engineers on this Definite Project Report.

W. J. TRUSS
Colonel, Corps of Engineers
District Engineer

Inclos.:
Drawings File Nos.
PT-4-1010, PT-4-1011,
PT-4-1012, PT-4-1013
Plates Nos. 2 and 6





KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	APP. BY

PAWTUXET RIVER FLOOD CONTROL

PAWTUXET RIVER WATERSHED

LOCATION MAP OF PROJECTS

PAWTUXET RIVER — RHODE ISLAND

IN SHEETS — SCALE: 1: 62,500 — SHEET NO.

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — JUNE 1944

SUBMITTED: C.D. Allen, ENGINEER, PROJECT ENGINEER

APPROVAL RECOMMENDED: D.S. Wyman, HEAD ENGINEER, CHIEF, ENGINEERING DIV.

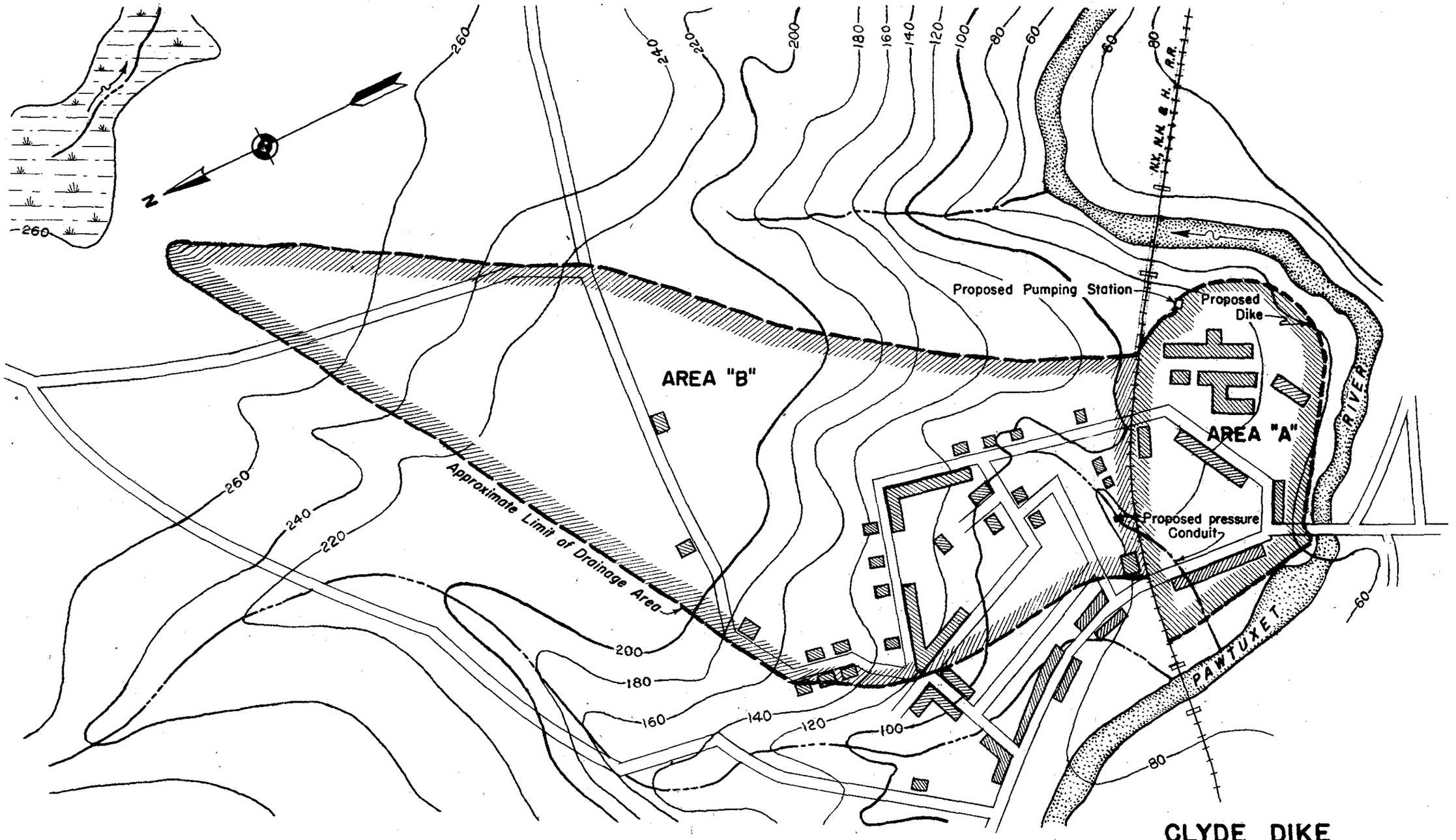
APPROVED: Alfred Wood, COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

PREPARED: W. Affleby, PROJECT/UNIT NO. 47

DRAWN: J.S.
TRACED: W.L.
CHECKED: M.R.C.

FILE NO. PT-4-1010

PLATE I



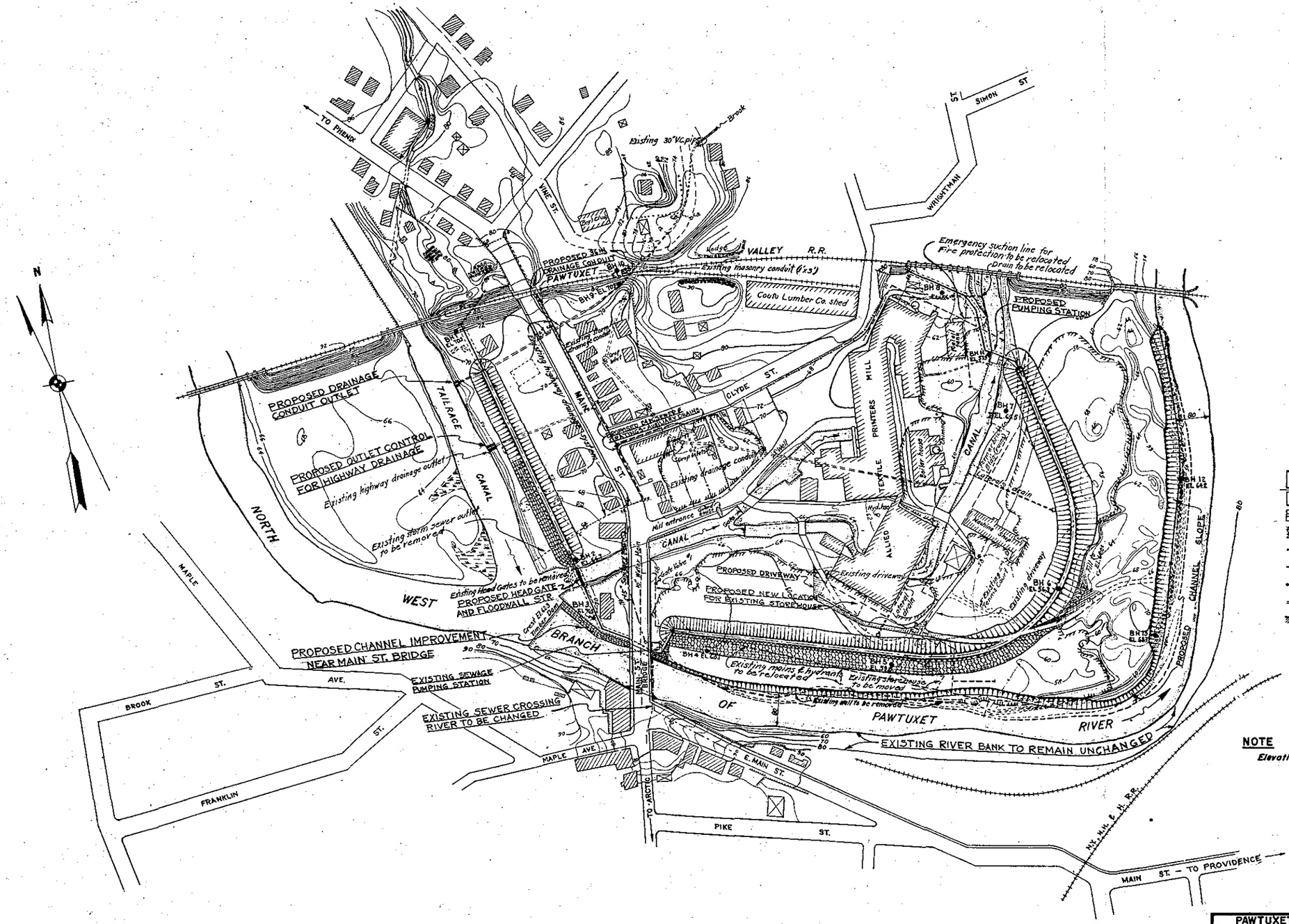
CLYDE DIKE

PAWUXET RIVER, R.I.

PROPOSED PROVISION FOR DISPOSAL OF INTERNAL DRAINAGE

SCALE: 1 IN. = 500 FT.

PLATE NO. 2



LEGEND

- Proposed earth dikes
- Proposed concrete walls
- Proposed riprap
- Existing water supply line
- Existing sanitary sewer
- Proposed steel sheet pile cutoff
- Proposed drains and laterals
- 1938 flood overflow limits

NOTE

Elevations refer to Mean Sea Level Datum.

KEY	DATE	REVISION (indicated by △)	REV.BY	CK.BY	AP.BY

PAWTUXET RIVER FLOOD CONTROL

CLYDE DIKE
GENERAL PLAN

PAWTUXET RIVER RHODE ISLAND

IN SHEETS SCALE: 1 IN. = 100 FT. SHEET NO.

100' 0 100' 200'

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944

SUBMITTED: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF ENGINEERING BY. HEAD ENGINEER

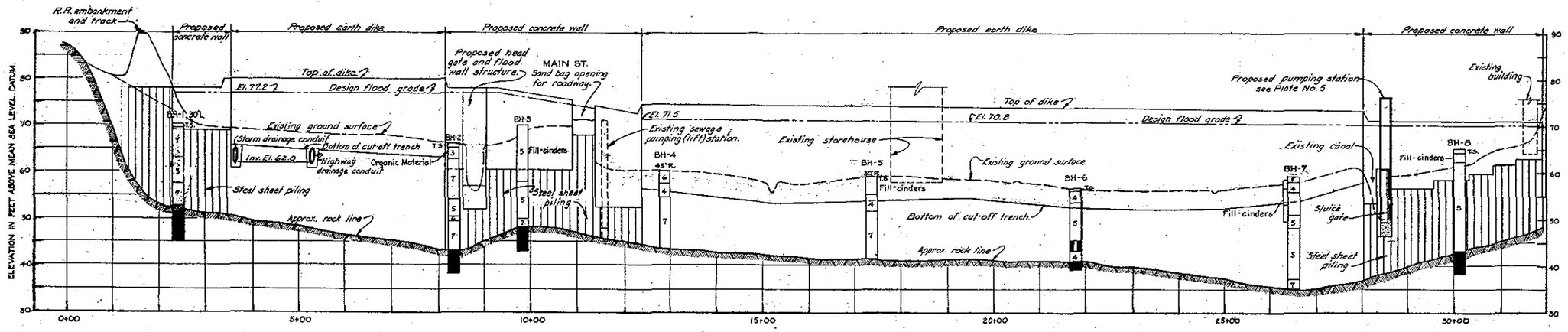
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

PREPARED: DRAWN: F.L.S. TRACED: CHECKED: K.V.C.

PROJECT UNIT NO. 4

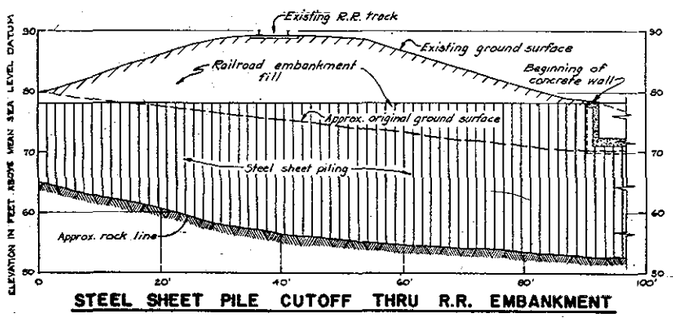
FILE NO. PT-4-1011

PLATE NO. 3



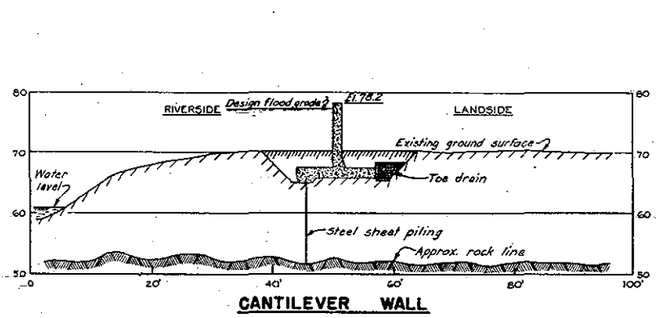
PROFILE ALONG ℄ DIKE

SCALE: HOR. 1"=100'
VERT. 1"=10'



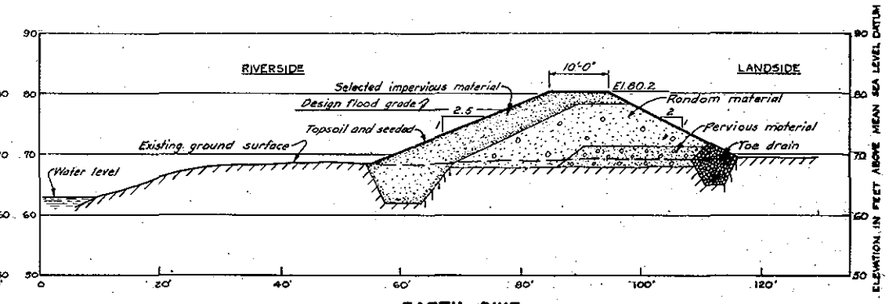
STEEL SHEET PILE CUTOFF THRU R.R. EMBANKMENT
STA. 1+30 TO STA. 2+30

SCALE: 1"=10'



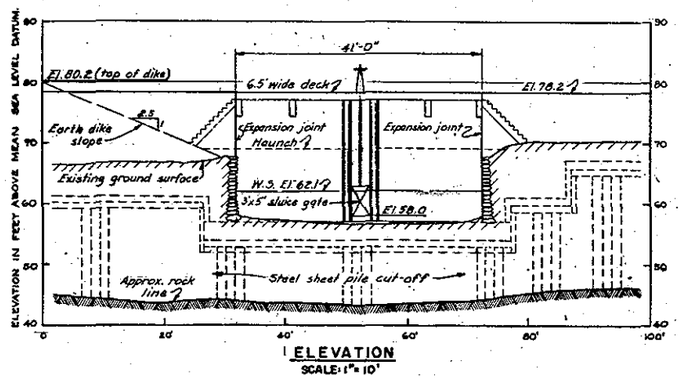
CANTILEVER WALL
STA. 2+70

SCALE: 1"=10'



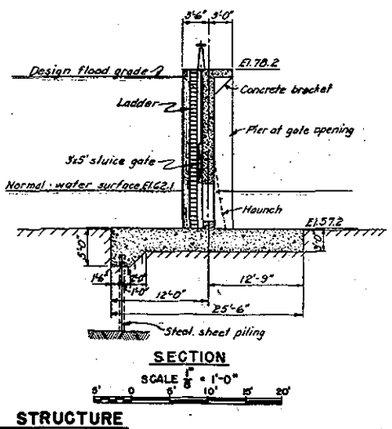
EARTH DIKE
STA. 5+00

SCALE: 1"=10'



ELEVATION

SCALE: 1"=10'



SECTION

SCALE 1"=1'-0"

HEADGATE AND FLOOD WALL STRUCTURE

KEY	DATE	REVISION (Indicated by △)	REV'BY	CK. BY	AP. BY

PAWTUXET RIVER FLOOD CONTROL

CLYDE DIKE

PROFILE AND SECTIONS

PAWTUXET RIVER RHODE ISLAND

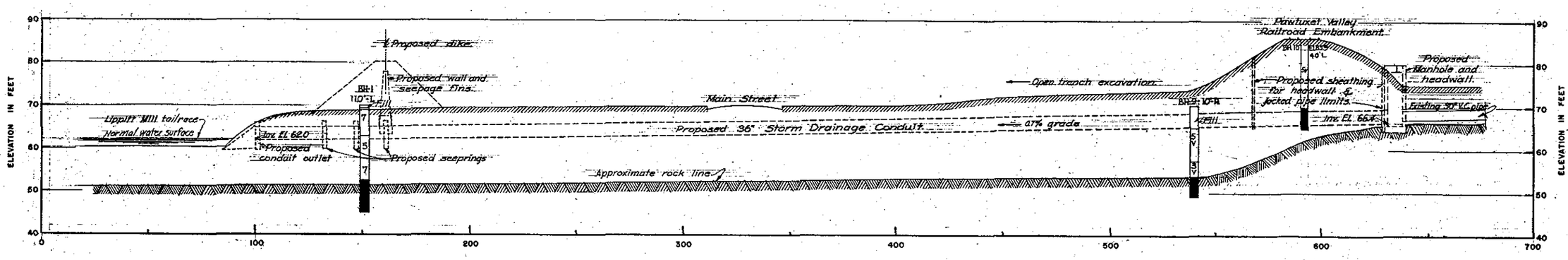
IN SHEETS SCALE: 1 IN. = 10 FT. SHEET NO.

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944

SUBMITTED:	APPROVAL RECOMMENDED:	APPROVED:
ENGINEER PROJECT ENGINEER	HEAD ENGINEER CHIEF, ENGINEERING DIV.	COL., CORPS OF ENGINEERS DISTRICT ENGINEER

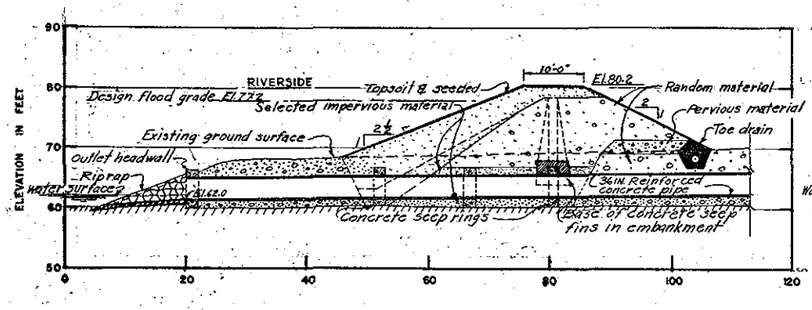
PREPARED: DRAWN: H.G.L.
TRACED:
CHECKED:
PROJECT UNIT NO.'S FILE NO. PT-4-1012

PLATE NO. 4



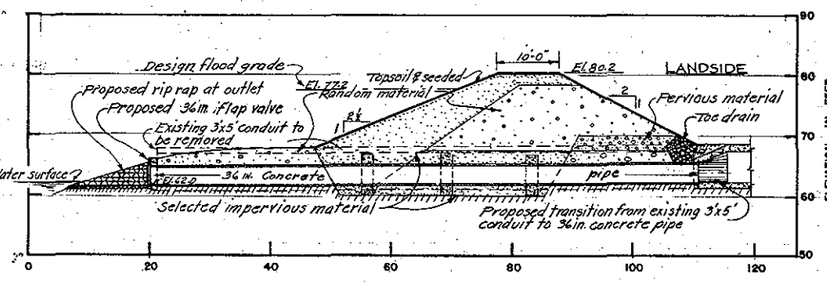
PROFILE ALONG ℄ STORM DRAINAGE DIVERSION CONDUIT

SCALE: HOR.- 1" = 20'
VERT.- 1" = 10'



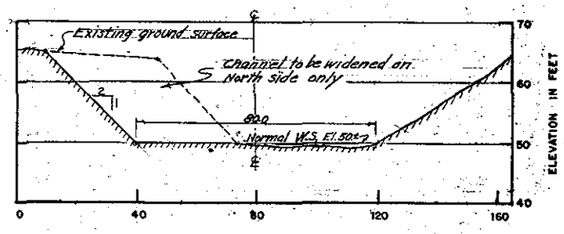
SECTION ALONG ℄ STORM DRAINAGE DIVERSION CONDUIT UNDER DIKE

SCALE: HOR.- 1" = 10'
VERT.- 1" = 10'



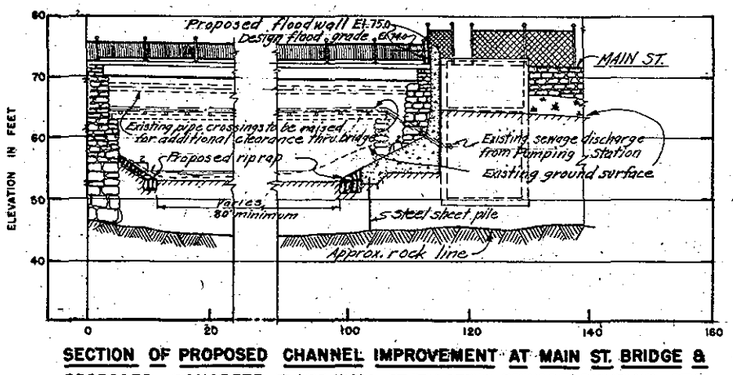
SECTION THRU DIKE ON ℄ HIGHWAY DRAINAGE CONDUIT

SCALE: HOR.- 1" = 10'
VERT.- 1" = 10'



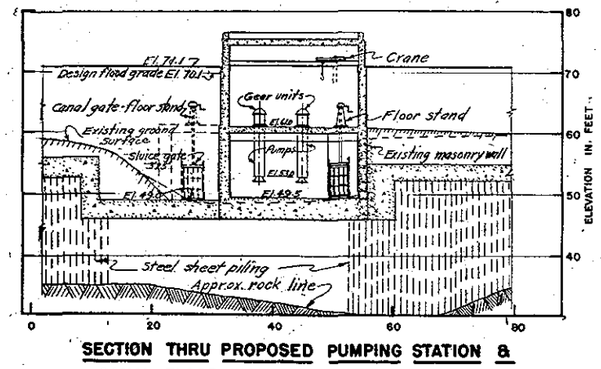
SECTION -CHANNEL IMPROVEMENT- MAXIMUM CUT

SCALE: HOR.- 1" = 20'
VERT.- 1" = 10'



SECTION OF PROPOSED CHANNEL IMPROVEMENT AT MAIN ST. BRIDGE & PROPOSED CONCRETE FLOOD WALL AT EXISTING SEWAGE PUMPING STA.

SCALE: HOR.- 1" = 10'
VERT.- 1" = 10'



SECTION THRU PROPOSED PUMPING STATION & CANAL FLOOD WALL AND GATE STRUCTURE

SCALE: HOR.- 1" = 10'
VERT.- 1" = 10'

KEY	DATE	REVISION (Indicated by △)	REV.BY	CK. BY	AP. BY

PAWTUXET RIVER FLOOD CONTROL

CLYDE DIKE
DETAILS & SECTIONS

PAWTUXET RIVER — RHODE ISLAND

IN SHEETS — SCALE: AS SHOWN — SHEET NO.

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944

SUBMITTED: ENGINEER, PROJECT ENGINEER

APPROVAL RECOMMENDED: HEAD, ENGINEER, CHIEF, ENGINEERING DIV.

APPROVED: COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

PREPARED: PROJECT UNIT NO. 4

DRAWN: M.A.Y.
TRACED:
CHECKED:

FILE NO. PT-4-1013

PLATE NO. 5

PROVIDENCE DISTRICT SOIL CLASSIFICATION

CLASS	DESCRIPTION OF MATERIAL
1	Graded from Gravel to Coarse Sand. – Contains little medium sand.
2	Coarse to Medium Sand. – Contains little gravel and fine sand.
3	Graded from Gravel to Medium Sand. – Contains little fine sand.
4	Medium to Fine Sand. – Contains little coarse sand and coarse silt.
5	Graded from Gravel to Fine Sand. – Contains little coarse silt.
6	Fine Sand to Coarse Silt. – Contains little medium sand and medium silt.
7	Graded from Gravel to Coarse Silt. – Contains little medium silt.
8	Coarse to Medium Silt. – Contains little fine sand and fine silt.
9	Graded from Gravel to Medium Silt. – Contains little fine silt.
10	Medium to Fine Silt. – Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10C	Medium Silt to Coarse Clay. – Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	Graded from Gravel or Coarse Sand to Fine Silt. – Contains little coarse clay.
12	Fine Silt to Clay. – Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12 C	Clay. – Contains little silt. Possesses behavior characteristics of clay.
13	Graded from Coarse Sand to Clay. – Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13C	Clay. – Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.